

CLAIMS

1. An apparatus for generating a three-phase pulse-width-modulation signal for a three-phase voltage inverter employing a semiconductor switching element, the apparatus
5 comprising:

a generating unit that generates the three-phase pulse-width-modulation signal based on a combination of three basic voltage vectors and a zero vector.

10 2. The apparatus according to claim 1, wherein the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios
15 for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120
25 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage vectors having a phase difference of 60 degrees and a zero vector based on the occurrence time ratio distributed.

30 3. The apparatus according to claim 1, wherein the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at

least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command

5 vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors

10 having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage vectors having a phase difference of 60 degrees and a zero 15 vector based on the occurrence time ratio distributed, with an occurrence time ratio of a basic voltage vector in a middle of the three basic voltage vectors having a phase difference of 60 degrees set to a predetermined value.

20 4. The apparatus according to claim 1, wherein the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios

25 for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and

30 a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three

vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage vectors having a phase difference of 60 degrees and a zero 5 vector based on the occurrence time ratio distributed, and the three-phase PWM-signal generating apparatus further comprises a switching unit that switches, based on at least one of a load state, an operation frequency, and an angle range of an inverter rotation angle of a motor 10 driven by the three-phase voltage inverter, generation of a three-phase PWM signal using two kinds of basic voltage vectors having a phase difference of 60 degrees and at least one kind of a zero vector produced by the producing unit and generation of a three-phase PWM signal using three 15 kinds of basic voltage vectors having phase differences of 60 degrees and one kind of a zero vector produced by the distributing unit.

5. The apparatus according to claim 1, wherein
20 the generating unit includes
a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 25 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and
a distributing unit that distributes an occurrence time ratio of the voltage command vector to 30 three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120

degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage vectors having a phase difference of 60 degrees and a zero vector based on the occurrence time ratio distributed, with
5 an occurrence time ratio of a basic voltage vector in a middle of the three basic voltage vectors having a phase difference of 60 degrees set to a predetermined value, and
the three-phase PWM-signal generating apparatus further comprises a switching unit that switches, based on
10 at least one of a load state, an operation frequency, and an angle range of an inverter rotation angle of a motor driven by the three-phase voltage inverter, generation of a three-phase PWM signal using two kinds of basic voltage vectors having a phase difference of 60 degrees and at
15 least one kind of a zero vector produced by the producing unit and generation of a three-phase PWM signal using three kinds of basic voltage vectors having phase differences of 60 degrees and one kind of a zero vector produced by the distributing unit.

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6. The apparatus according to claim 1, wherein
the generating unit includes
a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at
25 least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and
30 a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors

having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage

5 vectors having a phase difference of 120 degrees and at least a zero vector based on the occurrence time ratio distributed.

7. The apparatus according to claim 1, wherein

10 the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of

15 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage

25 vectors having a phase difference of 120 degrees and at least a zero vector based on the occurrence time ratio distributed, and

the three-phase PWM-signal generating apparatus

30 further comprises a switching unit that switches, based on at least one of a load state, an operation frequency, and an angle range of an inverter rotation angle of a motor driven by the three-phase voltage inverter, generation of a

three-phase PWM signal using two kinds of basic voltage vectors having a phase difference of 60 degrees and at least one kind of a zero vector produced by the producing unit and generation of a three-phase PWM signal using three 5 kinds of basic voltage vectors having phase differences of 120 degrees and one kind of a zero vector produced by the distributing unit.

8. The apparatus according to claim 1, wherein
10 the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 15 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to 20 three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the 25 voltage command vector, to create,

when an operation request range on a low speed side is not stringent, a first combination of three basic voltage vectors having a phase difference of 60 degrees and at least a zero vector based on the occurrence time ratio 30 distributed, and

when the operation request range on a low speed side is stringent, a second combination of three basic voltage vectors having a phase difference of 120 degrees

and at least a zero vector based on the occurrence time ratio distributed.

9. The apparatus according to claim 7, wherein
5 the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of
10 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to
15 three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the
20 voltage command vector, to create,

when an operation request range on a low speed side is not stringent, a first combination of three basic voltage vectors having a phase difference of 60 degrees and at least a zero vector based on the occurrence time ratio
25 distributed, and

when the operation request range on a low speed side is stringent, a second combination of three basic voltage vectors having a phase difference of 120 degrees and at least a zero vector based on the occurrence time
30 ratio distributed, and

the three-phase PWM-signal generating apparatus further comprises a switching unit that switches, based on at least one of a load state, an operation frequency, and

an angle range of an inverter rotation angle of a motor driven by the three-phase voltage inverter, generation of a three-phase PWM signal using two kinds of basic voltage vectors having a phase difference of 60 degrees and at

5 least one kind of a zero vector produced by the producing unit and generation of a three-phase PWM signal using, in a switching manner, three kinds of basic voltage vectors having phase differences of 60 degrees and one kind of a zero vector and three kinds of basic voltage vectors having
10 phase differences of 120 degrees and at least one kind of a zero vector produced by the distributing unit.

10. An apparatus for generating a three-phase pulse-width-modulation signal for a three-phase voltage inverter

15 employing a semiconductor switching element, the apparatus comprising:

a generating unit that generates the three-phase pulse-width-modulation signal based on a combination of three basic voltage vectors and two zero vectors.

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11. The apparatus according to claim 10, wherein the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at
25 least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and

30 a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors

having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage

5 vectors having a phase difference of 60 degrees and two zero vectors based on the occurrence time ratio distributed.

12. The apparatus according to claim 10, wherein the generating unit includes

10 a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a

15 corresponding zero vector based on the voltage command vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 20 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage

25 vectors having a phase difference of 60 degrees and two zero vectors based on the occurrence time ratio distributed, while changing occurrence time ratios for the two zero vectors at a predetermined rate.

30 13. The apparatus according to claim 10, wherein the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at

least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command

5 vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors

10 having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage vectors having a phase difference of 60 degrees and two 15 zero vectors based on the occurrence time ratio distributed, with an occurrence time ratio of a basic voltage vector in a middle of the three basic voltage vectors having a phase difference of 60 degrees set to a predetermined value.

20 14. The apparatus according to claim 10, wherein the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios 25 for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three

vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage vectors having a phase difference of 60 degrees and two 5 zero vectors based on the occurrence time ratio distributed, while changing occurrence time ratios for the two zero vectors at a predetermined rate with an occurrence time ratio of a basic voltage vector in a middle of the three basic voltage vectors having a phase difference of 60 10 degrees set to a predetermined value.

15. The apparatus according to claim 10, wherein the generating unit includes

a creating unit that creates two basic voltage 15 vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command 20 vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors 25 having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage vectors having a phase difference of 60 degrees and two 30 zero vectors based on the occurrence time ratio distributed, and

the three-phase PWM-signal generating apparatus further comprises a switching unit that switches, based on

at least one of a load state, an operation frequency, and an angle range of an inverter rotation angle of a motor driven by the three-phase voltage inverter, generation of a three-phase PWM signal using two kinds of basic voltage
5 vectors having a phase difference of 60 degrees and at least one kind of a zero vector produced by the producing unit and generation of a three-phase PWM signal using three kinds of basic voltage vectors having phase differences of 120 degrees and two kinds of zero vectors produced by the
10 distributing unit.

16. The apparatus according to claim 10, wherein the generating unit includes

a creating unit that creates two basic voltage
15 vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command
20 vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors
25 having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage vectors having a phase difference of 60 degrees and two
30 zero vectors based on the occurrence time ratio distributed, while changing occurrence time ratios for the two zero vectors at a predetermined rate, and

the three-phase PWM-signal generating apparatus

further comprises a switching unit that switches, based on at least one of a load state, an operation frequency, and an angle range of an inverter rotation angle of a motor driven by the three-phase voltage inverter, generation of a 5 three-phase PWM signal using two kinds of basic voltage vectors having a phase difference of 60 degrees and at least one kind of a zero vector produced by the producing unit and generation of a three-phase PWM signal using three kinds of basic voltage vectors having phase differences of 10 120 degrees and two kinds of zero vectors produced by the distributing unit.

17. The apparatus according to claim 10, wherein the generating unit includes

15 a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a 20 corresponding zero vector based on the voltage command vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 25 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage 30 vectors having a phase difference of 60 degrees and two zero vectors based on the occurrence time ratio distributed, with an occurrence time ratio of a basic voltage vector in a middle of the three basic voltage vectors having a phase

difference of 60 degrees set to a predetermined value, and the three-phase PWM-signal generating apparatus further comprises a switching unit that switches, based on at least one of a load state, an operation frequency, and

5 an angle range of an inverter rotation angle of a motor driven by the three-phase voltage inverter, generation of a three-phase PWM signal using two kinds of basic voltage vectors having a phase difference of 60 degrees and at least one kind of a zero vector produced by the producing

10 unit and generation of a three-phase PWM signal using three kinds of basic voltage vectors having phase differences of 120 degrees and two kinds of zero vectors produced by the distributing unit.

15 18. The apparatus according to claim 10, wherein the generating unit includes

 a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios

20 for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and

 a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120

25 degrees and constituting a zero vector corresponding to the voltage command vector, to create three basic voltage vectors having a phase difference of 60 degrees and two zero vectors based on the occurrence time ratio distributed,

while changing occurrence time ratios for the two zero vectors at a predetermined rate with an occurrence time ratio of a basic voltage vector in a middle of the three basic voltage vectors having a phase difference of 60

5 degrees set to a predetermined value, and

the three-phase PWM-signal generating apparatus further comprises a switching unit that switches, based on at least one of a load state, an operation frequency, and an angle range of an inverter rotation angle of a motor

10 driven by the three-phase voltage inverter, generation of a three-phase PWM signal using two kinds of basic voltage vectors having a phase difference of 60 degrees and at least one kind of a zero vector produced by the producing unit and generation of a three-phase PWM signal using three 15 kinds of basic voltage vectors having phase differences of 120 degrees and two kinds of zero vectors produced by the distributing unit.

19. An apparatus for generating a three-phase pulse-width-modulation signal for a three-phase voltage inverter employing a semiconductor switching element, the apparatus comprising:

a generating unit that generates the three-phase pulse-width-modulation signal based on a combination of 25 three basic voltage vectors and a zero vector and a combination of three basic voltage vectors and two zero vectors.

20. The apparatus according to claim 19, wherein

30 the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios

for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and

5 a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three
10 vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create a first combination of three basic voltage vectors having a phase difference of 60 degrees and a zero vector and a second combination of three
15 basic voltage vectors having a phase difference of 60 degrees and two zero vectors, in a switchable manner.

21. The apparatus according to claim 19, wherein
the generating unit includes

20 a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a
25 corresponding zero vector based on the voltage command vector; and

 a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three
30 vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the

voltage command vector, to create a first combination of three basic voltage vectors having a phase difference of 60 degrees and a zero vector and a second combination of three basic voltage vectors having a phase difference of 60 5 degrees and two zero vectors, in a switchable manner, while changing occurrence time ratios for the two zero vectors at a predetermined rate.

22. The apparatus according to claim 19, wherein
10 the generating unit includes

a creating unit that creates two basic voltage vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 15 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the 25 voltage command vector, to create a first combination of three basic voltage vectors having a phase difference of 60 degrees and a zero vector and a second combination of three basic voltage vectors having a phase difference of 60 degrees and two zero vectors, in a switchable manner, and

30 the three-phase PWM-signal generating apparatus further comprises a switching unit that switches, based on at least one of a load state, an operation frequency, and an angle range of an inverter rotation angle of a motor

driven by the three-phase voltage inverter, generation of a three-phase PWM signal using two kinds of basic voltage vectors having a phase difference of 60 degrees and at least one kind of a zero vector produced by the producing
5 unit and generation of a three-phase PWM signal using, in a switching manner, three kinds of basic voltage vectors having phase differences of 60 degrees and one kind of a zero vector and three kinds of basic voltage vectors having phase differences of 60 degrees and two kinds of zero
10 vectors produced by the distributing unit.

23. The apparatus according to claim 19, wherein
the generating unit includes

a creating unit that creates two basic voltage
15 vectors having a phase difference of 60 degrees and at least a zero vector by allocating occurrence time ratios for two basic voltage vectors having a phase difference of 60 degrees with a voltage command vector therebetween and a corresponding zero vector based on the voltage command
20 vector; and

a distributing unit that distributes an occurrence time ratio of the voltage command vector to three basic voltage vectors having a phase difference of 120 degrees including one of the two basic voltage vectors
25 having a phase difference of 60 degrees, using three vectors with equal lengths having a phase difference of 120 degrees and constituting a zero vector corresponding to the voltage command vector, to create a first combination of three basic voltage vectors having a phase difference of 60
30 degrees and a zero vector and a second combination of three basic voltage vectors having a phase difference of 60 degrees and two zero vectors, in a switchable manner, while changing occurrence time ratios for the two zero vectors at

a predetermined rate, and

the three-phase PWM-signal generating apparatus further comprises a switching unit that switches generation of a three-phase PWM signal using two kinds of basic
5 voltage vectors having a phase difference of 60 degrees and at least one kind of a zero vector produced by the producing unit and generation of a three-phase PWM signal using three kinds of basic voltage vectors having phase differences of 60 degrees and one kind of a zero vector and
10 three kinds of basic voltage vectors having phase differences of 60 degrees and two kinds of zero vectors produced by the distributing unit.